# PROFILED METAL SHEET

The present invention relates to the construction of composite slabs that include:

(a) profiled metal sheets; and

(b) a layer of hardened concrete or other suitable castable material on the sheets.

A major, although not the only, end use application of such composite slabs is as floors in buildings (which term includes car parks).

Another, although not the only, end use application of such composite slabs is as vertical wall panels.

Usually, profiled metal sheets include:

(a) parallel longitudinal ribs that are separated by pans; and

(b) male and female members at opposite sides of the sheets that enable adjacent sheets to be connected together in overlapping relationship by inserting a male member into a female member.

One of the failure modes of composite slabs is by longitudinal slip between profiled metal sheets and concrete or other castable material on the sheets.

An object of the present invention is to provide a composite slab that has improved longitudinal slip resistance compared with that of composite slabs known to the applicant.

In general terms, the present invention provides a profiled metal sheet for use in the construction of composite slabs. The sheet includes a plurality of parallel longitudinal ribs separated by pans and male and female members at opposite sides of the sheet that enable adjacent sheets to be connected together in overlapping relationship. At least one of the ribs, male members and female members has a side that extends from the pan that is adjacent the rib or the member. The side includes a re-entrant section and a corner section that connects the side and the adjacent pan. The corner section includes a plurality of regions at spaced intervals along the length of the corner section that extend outwardly compared with adjacent regions of the corner section. The spaced regions are provided to improve longitudinal slip resistance of composite slabs formed from the sheet.

In more specific terms, according to one aspect of the present invention there is provided a profiled metal sheet that includes: a plurality of parallel longitudinal ribs separated by pans, and male and female members at opposite sides of the sheet that enable adjacent sheets to be connected together by inserting a male member into a female member, at least one of the male and female members having a side that extends from the pan that is adjacent the member, the side including a re-entrant section, and a corner section that connects the side and the adjacent pan, and the corner section including a plurality of regions at spaced intervals along the length of the corner section that extend outwardly compared with adjacent regions of the corner section.

According to another aspect of the present invention there is provided a profiled metal sheet that includes: a plurality of parallel ribs separated by pans, and male and female members at opposite sides of the sheet

that enable adjacent sheets to be connected together by inserting a male member into a female member, each rib having a pair of opposed sides that extend from adjacent pans, at least one side including a re-entrant section, and a corner section that connects each side and the adjacent pan, and one corner section at a side that has a re-entrant section or at least one such corner section including a plurality of regions at spaced intervals along the length of the corner section that extend outwardly compared with adjacent regions of the corner section.

According to another aspect of the present invention there is provided a profiled metal sheet that includes: a plurality of parallel ribs separated by pans, and male and female members at opposite sides of the sheet that enable adjacent sheets to be connected together by inserting a male member into a female member, each rib having a pair of opposed sides that extend from adjacent pans, at least one of the male and female members having a side that extends from the pan that is adjacent the member, at least one side of the ribs including a re-entrant section, at least one side of the male and female members including a re-entrant section, and a corner section that connects each side of the ribs and the male and female members and the adjacent pans, and one corner section at a side that has a re-entrant section or at least one such corner section including a plurality of regions at spaced intervals along the length of the corner section that extend outwardly compared with adjacent regions of the corner section.

The applicant has found that the combined effect of the re-entrant sections and the outwardly extending regions improves the longitudinal slip resistance of composite slabs formed using the above described profiled metal sheets.

Specifically, the re-entrant sections lock together the concrete or other castable material and the sheet.

In addition, the location of the outwardly extending regions in the corner section or corner sections of the ribs and/or of the male members and/or of the female members is such that, when concrete slips longitudinally relative to the sheet and thereby generates lateral forces against the outwardly extending regions (which tend to push the regions inwardly), tensile stresses develop in the sheet transversely to the longitudinal direction of the ribs in response to the lateral forces, and the tensile stresses resist the concrete-generated lateral forces.

The applicant has found that such tensile stresses are not generated to the same extent with profiled metal sheets of composite slabs known to the applicant.

The outwardly extending regions may be any suitable shape.

Preferably the outwardly extending regions are in the form of crimps.

Preferably the crimps extend transversely to the lengthwise direction of the ribs.

The outwardly extending regions may be formed by any suitable means.

By way of example, the outwardly extending regions may be roll-formed in the profiled metal sheet.

Preferably the outwardly extending regions extend

at least 4mm beyond adjacent regions of the corner section.

More preferably the outwardly extending regions extend at least 5mm beyond the adjacent regions.

Preferably the spacing between the outwardly extending regions is at least 15mm.

More preferably the spacing between the outwardly extending regions is at least 30mm.

It is preferred particularly that the spacing between the outwardly extending regions be at least 50mm.

Preferably the spacing between the outwardly extending regions is less than 95mm.

More preferably the spacing between the outwardly extending regions is less than 80mm.

If the spacing between the outwardly extending regions is too small, the longitudinal shear resistance of concrete between the regions will be relatively low and the concrete will tend to shear.

On the other hand, if the spacing between the outwardly extending regions is too large, the outwardly extending regions will not provide sufficient resistance to longitudinal slip.

The re-entrant section may form a small part only of the side of the rib or the male member or the female member.

At the other extreme, the re-entrant section may form substantially all of the side of the rib or the male

member or the female member.

Preferably the opposed sides of each rib extend generally upwardly and inwardly towards each other from the adjacent pans.

According to the present invention there is also provided a composite slab that includes the above-described profiled metal sheet and a layer of hardened concrete or other suitable castable material on the sheet.

The present invention is described further by way of example with reference to the accompanying drawings, of which:

Figure 1 is a perspective view of one embodiment of a profiled metal sheet in accordance with the present invention;

Figure 2 is an end elevation of the sheet shown in Figure 1;

Figure 3 is an enlarged end elevation of a part of a composite slab formed from the sheet shown in Figure 2 which illustrates the forces generated by longitudinal slip of concrete relative to the sheet; and

Figure 4 is an enlarged end elevation of a part of a composite slab formed from another embodiment of a profiled metal sheet in accordance with the present invention.

The profiled metal sheets shown in the figures are described hereinafter in the context of the construction of composite floor slabs that include the profiled metal sheets and a layer of concrete on the upper surface of the sheets (as viewed in the figures).

The profiled metal sheet shown in Figures 1 to 3 is formed by roll-forming a flat sheet of steel.

The sheet includes two longitudinal parallel ribs generally identified by the numeral 5 separated by flat pans 7.

The sides of the sheet are formed as a male connection member 9 and a female connection member 11. The arrangement of the male and female members 9, 11 enables adjacent sheets to be positioned together in overlapping relationship with a leak proof lap join by inserting the male member 9 of one sheet into the female member 11 of the adjacent sheet.

Each rib 5 of the sheet includes a top flange 13 which separates two sides, generally identified by the numeral 15.

Each side 15 includes a first section 17 that extends outwardly and downwardly from the top flange 5, a second section 19 that extends downwardly and inwardly from the lower edge of the first section 17, and a third section 21 that extends downwardly and outwardly from the lower edge of the second section 19 and connects the side and the adjacent pan 7.

The junction of the third section 21 and the pan 7 forms a corner section 21. Preferably the angle of the corner section 21, as described by the third section 21 and the pan 7 is between 70-100°.

The junction of the second section 19 and the third section 21 forms a corner section 33. Preferably the angle described by the second section 19 and the third section 21 less than 100°, more preferably less than 90°.

The second section 19 defines a re-entrant section of the rib 5.

The sheet further includes a series of regions 23 in the corner 21 on the left side of the left rib 5 shown in the figures. The regions 23 are provided to cooperate with the re-entrant sections 19 of the ribs 5 to contribute to the longitudinal slip resistance of a composite slab formed from the sheet and concrete and other suitable castable material on the sheet. The regions 23 are at spaced intervals along the length of the corner 21.

The regions 23 are outwardly extending regions when compared with adjacent regions of the corner 21.

Preferably the spacing of the regions 23 is 30-80mm.

Preferably the regions 23 extend outwardly at least 5mm from adjacent regions of the corner 21.

The regions 23 are provided to cooperate with the re-entrant sections 19 of the ribs 5 to contribute to the longitudinal slip resistance of a composite slab formed from the sheet and concrete and other suitable castable material on the sheet. As described above, the re-entrant sections 19 lock together the sheet and the concrete. More particularly, as shown in Figure 3, the concrete generates a bearing force $F_1$ against the corner 33 of the re-entrant section 19 and the third section 12 of the rib 5 shown in the Figure. In effect, the bearing force $F_1$ pins the corner 33. In addition, when there is longitudinal slip of concrete that generates lateral forces that act against the regions 23, tensile stresses are generated in sections of the sheet that are in the

immediate vicinity of the regions 23 in response to the lateral forces, and the tensile stresses counter the lateral forces and resist inward movement of the regions 23. With reference to Figure 3, the lateral forces are identified by the letter $F_2$ and the tensile stresses are identified by the letter T.

The overall effect of the tensile stresses is that the sheet has very high longitudinal slip resistance.

Figure 4 illustrates an enlarged section of a composite slab that includes another embodiment of a profiled metal sheet.

As with the sheet shown in Figures 1 to 3, the sheet shown in Figure 4 includes a rib 5 that has a top flange 13 which separates two sides 15.

The sides 15 also include re-entrant sections. However, in this embodiment the sides 15 form a dovetail formation, whereby in effect the re-entrant sections are substantially all of the sides 15. Nevertheless, the forces acting on the sheet are the same for both embodiments.

Many modifications may be made to the preferred embodiment of the present invention described above without departing from the spirit and scope of the invention.

By way of example, whilst the embodiment described above in relation to Figures 1 to 3 include outwardly extending regions 23 along the length of the corner 21 on the left side of the left rib 5 shown in the figures, the present invention is not limited to this arrangement and the regions 23 may be provided in any one or more of the corners 21 of the ribs 5.

In addition, the present invention extends to arrangements in which one or both of the male and female members 7, 9 include re-entrant sections and outwardly extending regions in the corners of the male and female members 7, 9.

In addition, the present invention extends to other profiles of ribs and male and female members which have re-entrant sections.

CLAIMS:

1. A profiled metal sheet that includes: a plurality of parallel longitudinal ribs separated by pans, and male and female members at opposite sides of the sheet that enable adjacent sheets to be connected together by inserting a male member into a female member, at least one of the male and female members having a side that extends from the pan that is adjacent the member, the side including a re-entrant section, and a corner section that connects the side and the adjacent pan, and the corner section including a plurality of regions at spaced intervals along the length of the corner section that extend outwardly compared with adjacent regions of the corner section.

2. A profiled metal sheet that includes: a plurality of parallel ribs separated by pans, and male and female members at opposite sides of the sheet that enable adjacent sheets to be connected together by inserting a male member into a female member, each rib having a pair of opposed sides that extend from adjacent pans, at least one side including a re-entrant section, and a corner section that connects each side and the adjacent pan, and one corner section at a side that has a re-entrant section or at least one such corner section including a plurality of regions at spaced intervals along the length of the corner section that extend outwardly compared with adjacent regions of the corner section.

3. A profiled metal sheet that includes: a plurality of parallel ribs separated by pans, and male and female members at opposite sides of the sheet that enable adjacent sheets to be connected together by inserting a male member into a female member, each rib having a pair of opposed sides that extend from adjacent pans, at least one of the male and female members having a side that

extends from the pan that is adjacent the member, at least one side of the ribs including a re-entrant section, at least one side of the male and female members including a re-entrant section, and a corner section that connects each side of the ribs and the male and female members and the adjacent pans, and one corner section at a side that has a re-entrant section or at least one such corner section including a plurality of regions at spaced intervals along the length of the corner section that extend outwardly compared with adjacent regions of the corner section.

4. The profiled metal sheet defined in any one of the preceding claims wherein the outwardly extending regions are in the form of crimps.

5. The profiled metal sheet defined in any one of the preceding claims wherein the outwardly extending regions may be roll-formed in the profiled metal sheet.

6. The profiled metal sheet defined in any one of the preceding claims wherein the outwardly extending regions extend at least 4mm beyond adjacent regions of the corner section.

7. The profiled metal sheet defined in any one of the preceding claims wherein the outwardly extending regions extend at least 5mm beyond the adjacent regions of the corner section.

8. The profiled metal sheet defined in any one of the preceding claims wherein the spacing between the outwardly extending regions is at least 15mm.

9. The profiled metal sheet defined in any one of the preceding claims wherein the spacing between the outwardly extending regions is at least 30mm.

10. The profiled metal sheet defined in any one of the preceding claims wherein the spacing between the outwardly extending regions is at least 50mm.

11. The profiled metal sheet defined in any one of the preceding claims wherein the spacing between the outwardly extending regions is less than 95mm.

12. The profiled metal sheet defined in any one of the preceding claims wherein the spacing between the outwardly extending regions is less than 80mm.

13. The profiled metal sheet defined in any one of the preceding claims wherein the re-entrant section forms a small part only of the side of the rib or the male member or the female member.

14. The profiled metal sheet defined in any one of claims 1 to 12 wherein the re-entrant section forms substantially all of the side of the rib or the male member or the female member.

15. A composite slab that includes profiled metal sheet defined in any one of the preceding claims and a layer of hardened concrete or other suitable castable material on the sheet.

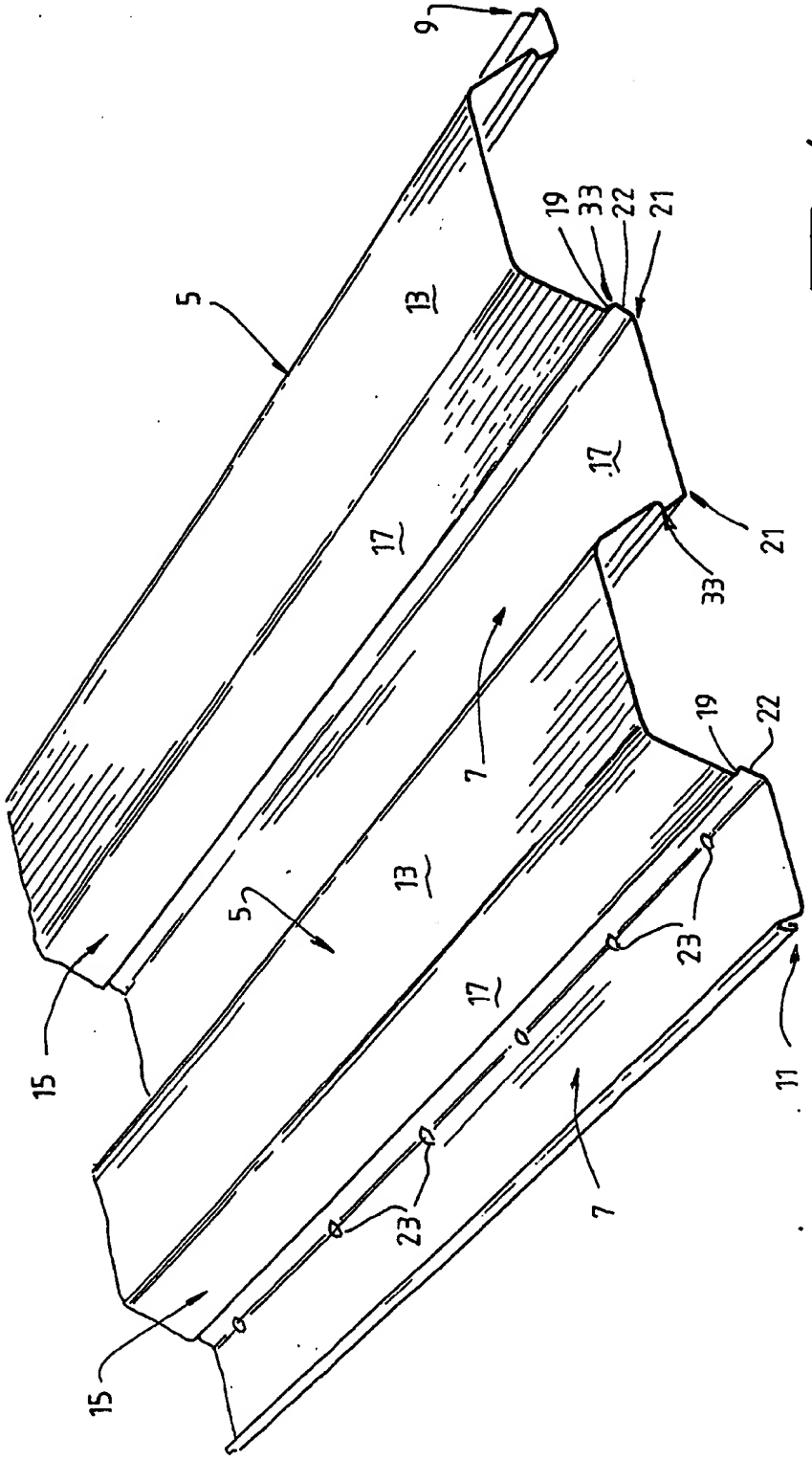


Fig. 1.

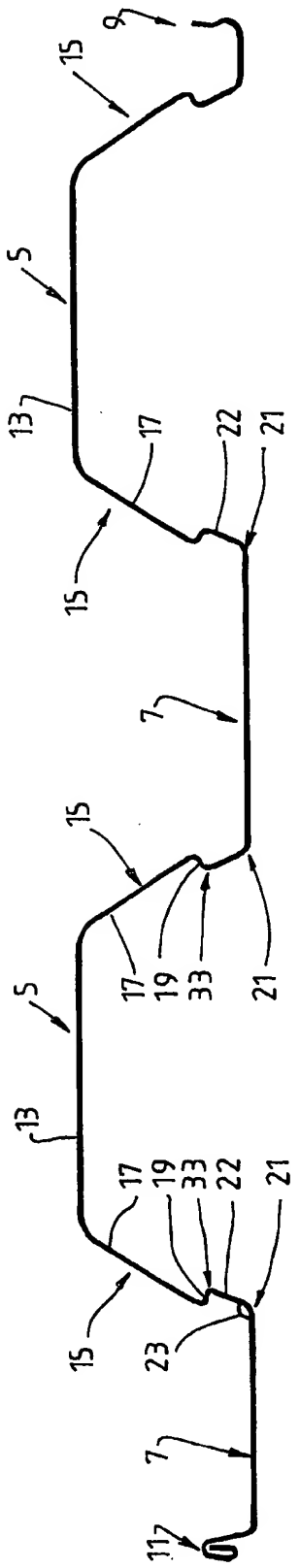


FIG. 2.

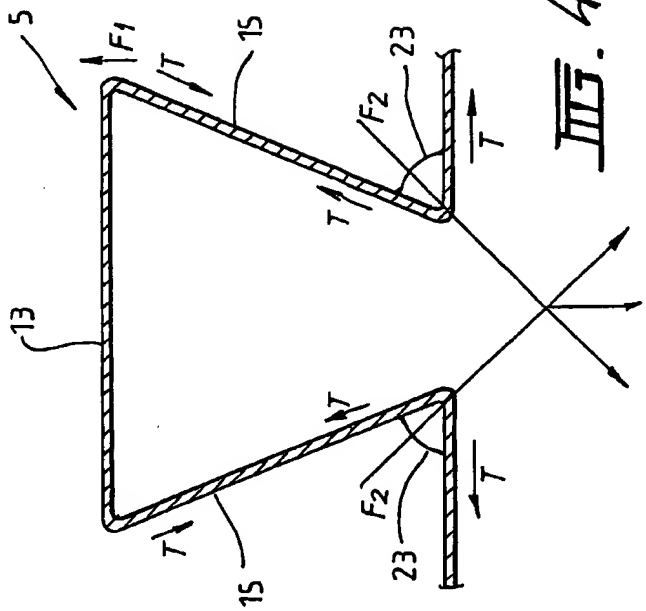


FIG. 4.

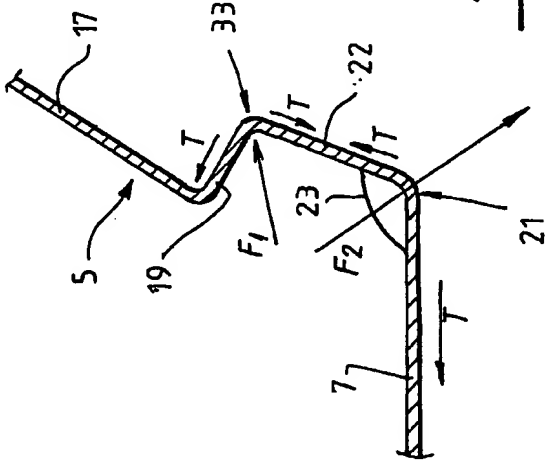


FIG. 3.